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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Attorney Docket No.: 2418.43US01

Tetsuyuki Kurata et al.

Application No.: 10/009,937 Examiner: Unknown

Filed: December 10, 2001 Group Art Unit: Unknown

For: PRETILT ANGLE MEASURING METHOD AND MEASURING APPARATUS

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

In the Claims

Please substitute the following amended claims for those currently pending:

1. A method for detecting a pretilt angle of an element in which the direction of orientation of molecules is twisted from a light incident side to light outgoing side, the method comprising:

measuring transmitted light intensity of light that has come from the light incident side for a plurality of light incident angles;

analyzing dependence of the measured transmitted light intensity for the plurality of light incident angles; and

determining the pretilt angle of the element based upon the analysis results.

2. A method for detecting a pretilt angle of an element in which the direction of orientation of molecules is twisted from a light incident side to a light outgoing side, the method comprising:

measuring transmitted light intensity of light that has come from the light incident side for a plurality of light incident angles and at a plurality of optical element arrangements for each light incident angle;

analyzing dependence of the measured transmitted light intensity for the plurality of light incident angles; and

determining the pretilt angle of the element based upon the analysis results.

3. (Amended) The method as described in Claim 2, wherein in the step of analyzing the dependence of the measured transmitted light intensity for the plurality of light incident angles, an apparent retardation for the plurality of light incident angles is determined based upon the measured transmitted light intensity for the plurality of light incident angles, and in the step of detecting the pretilt angle of the element based upon the analysis results, the pretilt angle of the element is determined based upon the determined apparent retardation for the plurality of light incident angles.

4. (Amended) The method as described in Claim 2, wherein in the step of analyzing the dependence of the measured transmitted light intensity for the plurality of light incident angles, Stokes parameters for the plurality of light incident angles are determined based upon the measured transmitted light intensity for the plurality of light incident angles, and in the step of detecting the pretilt angle of the element based upon the analysis results, the pretilt angle of the element is determined based upon the determined Stokes parameters for the plurality of light incident angles.

5. The method as described in Claim 4, wherein in the step of detecting the pretilt angle of the element based upon the analysis results, an apparent retardation for the plurality of light incident angles is determined based upon the determined Stokes parameters for the plurality of light incident angles, and the pretilt angle of the element is determined based upon the determined apparent retardation for the plurality of light incident angles.

6. (Amended) The method as described in Claim 5, wherein the step of detecting the pretilt angle of the element based upon the analysis results, an average tilt angle is determined based upon the determined apparent retardation for the plurality of light incident angles, and the pretilt angle is determined based upon the determined average tilt angle.

7. (Amended) The method as described in Claim 6, wherein in the step of measuring the transmitted light intensity for the plurality of light incident angles, the transmitted light intensity is measured in a state in which the following relationship is valid between the orientation direction α^{in} (rad) of molecules at the light incident side interface of the element and the twist angle Φ (rad) of the element:

$$\tan \alpha^{in} = -\frac{\Phi - \sin \Phi}{1 - \cos \Phi} .$$

8. (Amended) The method as described in Claim 7, wherein in the step of measuring the transmitted light intensity for the plurality of light incident angles, monochromatic light is incident from the light incident side.

9. An apparatus for detecting a pretilt angle arranged in the following sequence: a light source, a polarizer, an element in which the direction of orientation of molecules is twisted

from a light incident side to a light outgoing side, an analyzer, and a photodetector, wherein the apparatus also comprises a processing device for processing output signals from the photodetector, the processing device analyzes the dependence of transmitted light intensity on a light incident angle based upon the transmitted light intensities for a plurality of light incident angles that were output from the photodetector, and detects the pretilt angle of the element based upon the analysis results.

10. The apparatus as described in Claim 9, wherein a quarter-wave plate is provided between the element and the analyzer.

11. (Amended) The apparatus as described in Claim 10, wherein the processing device analyzes the dependence of the transmitted light intensity on the light incident angle based upon the transmitted light intensities for a plurality of optical element arrangements for each of the plurality of light incident angles that was output from the photodetector, and detects the pretilt angle of the element based upon the analysis results.

12. (Amended) The apparatus as described in Claim 11, wherein the processing device detects an apparent retardation for the plurality of light incident angles based upon the transmitted light intensities output from the photodetector and detects the pretilt angle of the element based upon the determined apparent retardation for the plurality of light incident angles.

13. (Amended) The apparatus as described in Claim 11, wherein the processing device calculates Stokes parameters for the plurality of light incident angles based upon the transmitted light intensity output from the photodetector and determines the pretilt angle of the element based upon the determined Stokes parameters for the plurality of light incident angles.

14. The apparatus as described in Claim 13, wherein the processing device further calculates an apparent retardation for a plurality of light incident angles based upon the determined Stokes parameters for the plurality of light incident angles and determines the pretilt angle of the element based upon the determined apparent retardation for the pluralit of light incident angles.

15. (Amended) The apparatus as described in Claim 14, wherein the processing device determines the average tilt angle based upon the determined apparent retardation for the plurality of light incident angles and determines the pretilt angle based upon the determined average tilt angle.

16. (Amended) The apparatus as described in Claim 15, wherein the pretilt angle is determined based upon the transmitted light intensity in a state in which the following relationship is valid between the orientation direction α^{in} (rad) of molecules at the light incident side interface of the element and the twist angle Φ (rad) of the element:

$$\tan \alpha^{in} = -\frac{\Phi - \sin \Phi}{1 - \cos \Phi} .$$

17. (Amended) The apparatus as described in Claim 16, comprising a light source emitting monochromatic light or a converter for converting the light emitted by a light source into monochromatic light.

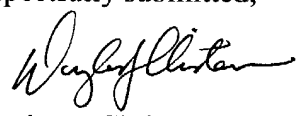
REMARKS

Claims 1-17 are pending. By this Amendment, claims 3- 4, 6-8, 11-13 and 15-17 are amended.

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,



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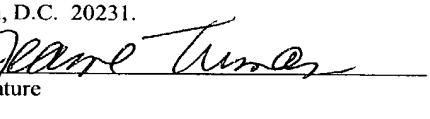

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ATTACHMENT
REDLINED AMENDMENT

Claims As Amended

Please substitute the following amended claims for those currently pending:

3. (Amended) The method as described in [Claim 1 or] Claim 2, wherein in the step of analyzing the dependence of the measured transmitted light intensity for the plurality of light incident angles, an apparent retardation for the plurality of light incident angles is determined based upon the measured transmitted light intensity for the plurality of light incident angles, and in the step of detecting the pretilt angle of the element based upon the analysis results, the pretilt angle of the element is determined based upon the determined apparent retardation for the plurality of light incident angles.

4. (Amended) The method as described in [Claim 1 or] Claim 2, wherein in the step of analyzing the dependence of the measured transmitted light intensity for the plurality of light incident angles, Stokes parameters for the plurality of light incident angles are determined based upon the measured transmitted light intensity for the plurality of light incident angles, and in the step of detecting the pretilt angle of the element based upon the analysis results, the pretilt angle of the element is determined based upon the determined Stokes parameters for the plurality of light incident angles.

6. (Amended) The method as described in [Claim 3 or] Claim 5, wherein the step of detecting the pretilt angle of the element based upon the analysis results, an average tilt angle is determined based upon the determined apparent retardation for the plurality of light incident angles, and the pretilt angle is determined based upon the determined average tilt angle.

7. (Amended) The method as described in [any claim of Claims 3 to] Claim 6, wherein in the step of measuring the transmitted light intensity for the plurality of light incident angles, the transmitted light intensity is measured in a state in which the following relationship is valid between the orientation direction α^{in} (rad) of molecules at the light incident side interface of the element and the twist angle Φ (rad) of the element:

$$\tan \alpha^{in} = -\frac{\Phi - \sin \Phi}{1 - \cos \Phi} .$$

8. (Amended) The method as described in [any of Claims 1 to] Claim 7, wherein in the step of measuring the transmitted light intensity for the plurality of light incident angles, monochromatic light is incident from the light incident side.

11. (Amended) The apparatus as described in [Claim 9 or] Claim 10, wherein the processing device analyzes the dependence of the transmitted light intensity on the light incident angle based upon the transmitted light intensities for a plurality of optical element arrangements for each of the plurality of light incident angles that was output from the photodetector, and detects the pretilt angle of the element based upon the analysis results.

12. (Amended) The apparatus as described in [any of Claims 9 to] Claim 11, wherein the processing device detects an apparent retardation for the plurality of light incident angles based upon the transmitted light intensities output from the photodetector and detects the pretilt angle of the element based upon the determined apparent retardation for the plurality of light incident angles.

13. (Amended) The apparatus as described in [any of Claims 9 to] Claim 11, wherein the processing device calculates Stokes parameters for the plurality of light incident angles based

upon the transmitted light intensity output from the photodetector and determines the pretilt angle of the element based upon the determined Stokes parameters for the plurality of light incident angles.

15. (Amended) The apparatus as described in [Claim 12 or] Claim 14, wherein the processing device determines the average tilt angle based upon the determined apparent retardation for the plurality of light incident angles and determines the pretilt angle based upon the determined average tilt angle.

16. (Amended) The apparatus as described in [any of Claims 12 to] Claim 15, wherein the pretilt angle is determined based upon the transmitted light intensity in a state in which the following relationship is valid between the orientation direction α^{in} (rad) of molecules at the light incident side interface of the element and the twist angle Φ (rad) of the element:

$$\tan \alpha^{in} = -\frac{\Phi - \sin \Phi}{1 - \cos \Phi} .$$

17. (Amended) The apparatus as described in [any of Claims 9 to] Claim 16, comprising a light source emitting monochromatic light or a converter for converting the light emitted by a light source into monochromatic light.